Careful design and assessment of alarm systems is required to ensure that operators do not end up 'driving to alarms' rather than remaining in active control of the system.

All of this can be distracting for the seafarer, who consequently may have to keep abreast of a large number of alarms at any given time. Confusion may easily arise from alarms whose sources and implications are not understood. Alarms, therefore, can increase the seafarer's workload and lead to information overload," says Dr Jonathan Earthy, Principal Human Factors Specialist, Lloyd's Register.

"In such instances there is a chance that genuine alarms arising from ship-critical systems which require attention will be lost in the noise. For alarms to fulfil their intended purpose – to reduce operator workload – they need to be designed so that the seafarer is not required to monitor several sets of parameters at the same time."

System design
Alarm and indication specification for complex systems requires analysis from a functional viewpoint that considers operability and usability. This can present difficulties to design teams accustomed to detailed prescriptive specifications and the immediacy of physical systems. The consequence for seafarers can be subtle misunderstandings of how the system is meant to be operated, which can lead to severe consequences in abnormal conditions. There is a definite role for an integrator in such design activities to manage this emergent risk, and there is a need for the owner and crew to be involved so that the real risks, as experienced by the users, can be taken into account when designing complex systems.
The selection of appropriate alarm channels is not necessarily simple, and prescribed alarm channels may not be appropriate for particular system designs or configurations. The introduction of redundant systems and multiple reversionary operating modes further complicates alarm system design.

Concerns that are less immediately apparent arise from the inappropriate use of alarms to communicate with the seafarer, e.g. as a substitute for clear mode and status indication. Without effective displays to support mode awareness it is difficult to convey the state of the system to the seafarer. Combined with the increase in automation, the use of alarms for status indication can change the seafarer’s role to one of passive machine minding rather than active system control.

**Assessing alarm systems**
Recognising that the primary function of an alarm system is to convey information to the seafarer efficiently and effectively, consideration of the usability of the system in any assessment is paramount. Human variability and adaptability, however, frequently make assessment of the human element somewhat more demanding than traditional marine equipment testing. The need to consider the ‘context of use’ in many human element assessments limits the value of prescriptive design guidance. Assessment approaches that take context into account are also new to much of the marine sector. Lloyd’s Register has been in the vanguard of developing standards that can be used to assess these aspects of user interaction with complex systems, using approaches and principles based on process assessment.

While many of the essential features of an alarm system can be readily assessed using well-established ergonomic design criteria, aspects related to seafarer workload can only be properly assessed in a simulated trial as their assessment requires information to be obtained from the user. Topics relating to the use of alarm systems which can be assessed include ease of understanding and ease of navigation around the alarm system.

The design of facilities used to present alarms can be assessed, ranging from workstation design, through display design, to the design of individual alarm messages and the design of audible alarms. Topics related to the location of alarms can be examined, e.g. alarm aspects of the bridge, the engine room, the engine control room and accommodation spaces. Other aspects of alarm system design which can be examined include the integration of computer and traditional alarms and system integrity as a whole. The need for procedures for responding to alarms and for the management of the alarm system can also be examined, including topics such as handover of shelved alarms and transfer of station in control.

**The way ahead**
Some aspects of alarm system design are determined by regulatory requirements and recommendations such as the IMO Code on Alarms and Indicators, but there are many aspects that are not. Supply chain management and liability issues can further complicate the achievement of a successful solution.

“Taking into account our own experiences, we have drawn on best practice from other sectors, adapted it for maritime use and have developed two new services to assist owners and yards in design, management and operation of alarm systems,” says Earthy. “These services do not require specialist ergonomic expertise and have been designed to be carried out in conjunction with regular classification surveys, following tailoring of standard design assessment checklists to suit ship type, classification notations and the alarm system technology.”

We can provide guidance during the design stage at system level and on aspects related to the equipment under control, such as prioritisation and grouping, as well as user-interface design.

We can also support the effective management of alarms by examining the activities undertaken to ensure that the alarm system alerts, informs and guides the watchkeeper in taking timely action. This service is based on the premise that the effective management of alarm systems has become important to the safe and effective operation of modern ships. The extent to which these activities can be undertaken will be based on the age of the ship, as implementing thorough-going changes on an older ship with older equipment may not be practical, although the operator may seek an improvement in shipboard operations.

“We believe that these alarm services will provide considerable benefits to safety and ease of operation,” says Earthy, “and will continue to provide owners and seafarers with operational advantages for some time to come.”

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